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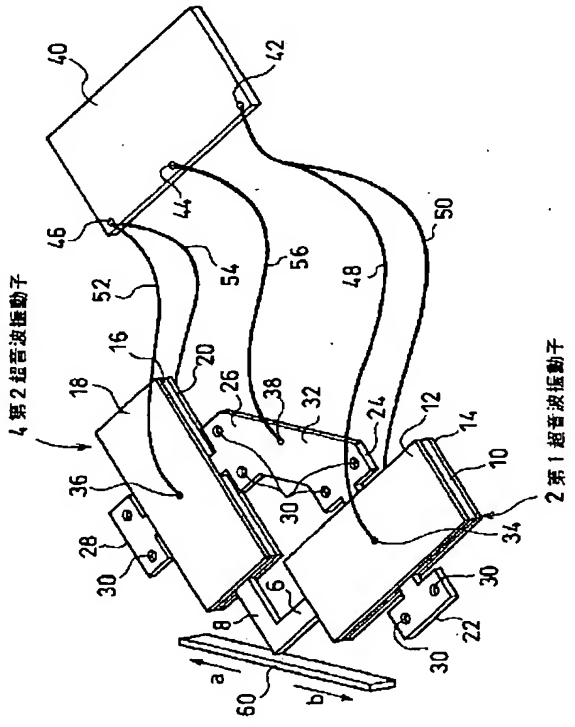
(54)【発明の名称】　超音波駆動モータ

(57)【要約】

【課題】移動体を正逆方向に移動可能でかつ従来の正逆切り替え操作レバーを不要つまりそれのアクチュエータを不要として正逆切り替え操作が簡易で移動効率が高くかつ全体の形状が簡易でコスト的にも安くそのうえ薄型化、小型化を容易には図れるようにする。

【解決手段】電気信号の印加により第１共振周波数ｆ１で振動するものでかつこの振動による伸縮方向側端部に振動片を備えた第１超音波振動子２と、電気信号の印加により前記第１共振周波数ｆ１と異なる第２共振周波数ｆ２で振動するものでかつ振動による伸縮方向側端部に振動片を備えた第２超音波振動子４とを有し、両超音波振動子２，４は互いに対して所定角度を有して配置されかつそれぞれの振動片６，８が接続されている構成。



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【特許請求の範囲】

【請求項１】電気信号の印加により第１共振周波数で振動するものでかつこの振動による伸縮方向側端部に振動片を備えた第１超音波振動子と、電気信号の印加により前記第１共振周波数と異なる第２共振周波数で振動するものでかつ振動による伸縮方向側端部に振動片を備えた第２超音波振動子とを有し、前記両超音波振動子は互いに対して所定角度を有して配置されかつそれぞれの振動片が互いに接続されていることを特徴とする超音波駆動モータ。

【請求項２】前記各超音波振動子それぞれが、振動子部材とこれの両面それぞれに設けられた圧電部材とで構成されかつ前記振動子部材の長手方向端部に前記振動片が設けられていることを特徴とする請求項１に記載の超音波駆動モータ。

【請求項３】導電性弾性部材でもって前記両超音波振動子それぞれの振動子部材と前記両超音波振動子それぞれを固定するための固定部材とが共通に形成され、かつその固定部材が前記両超音波振動子それぞれの伸縮方向振動モードの節に対応する位置に設けられていることを特徴とする請求項１または２記載の超音波駆動モータ。

【請求項４】前記両超音波振動子それぞれの長手方向の長さが異なることで前記共振周波数が互いに異なっていることを特徴とする請求項１ないし３いずれか記載の超音波駆動モータ。

【請求項５】前記両振動体それぞれの圧電部材は互いに弾性定数が異なっていることを特徴とする請求項１ないし３いずれか記載の超音波駆動モータ。

【請求項６】前記両振動体それぞれに対する固定部材が伸縮方向の振動モードの節の両側位置に設けられていることを特徴とする請求項１ないし３いずれか記載の超音波駆動モータ。

【請求項７】前記両振動体それぞれに対する固定部材が伸縮方向振動モードの節の片側位置に設けられていることを特徴とする請求項１ないし３いずれか記載の超音波駆動モータ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は超音波駆動モータに関する。

【０００２】

【従来の技術】超音波駆動モータはそれが備える超音波振動子の伸縮往復運動を利用して移動体を移動させるものであるが、その１つの方式としては超音波振動子の長手方向における伸縮振動を利用するものがある。このような超音波駆動モータは例えば特公昭５９－３７６７２号公報にも記述されているが、例えば図７を参照して説明するように超音波振動子１００を振動子部材１０２の両面に圧電部材１０４を設けて構成し、超音波振動子１００の矢印１０６で示される伸縮方向の一方端部の振動片１０６を移動体１０８に対して傾斜させて取り付けてなり、超音波振動子１００の矢印方向の伸縮による振動運動を移動体１１０の矢印１１２で示される移動方向に変換できるようになっている。

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【０００３】また、こうした方式の超音波駆動モータを１組以上用いて移動体の正逆方向に直線運動できるようにした超音波駆動モータも特開昭５９－１９４６７８号公報などにも提案されている。この超音波駆動モータについて図８を参照して説明すると、まず、図８ａで示すように前記と同じ構成の超音波振動子１１４，１１６を備え、図示していない切り替えレバーでもって矢印１１８方向に伸縮する一方の超音波振動子１１４を矢印１２０方向に切り替え、その振動片１２１を移動体１２２に接触させたうえで振動させて移動体１２２を正方向１２４に移動させ、この際、切り替えレバーでは矢印１２６方向に振動する他方の超音波振動子１１６を矢印１２８方向に移動させてその振動片１３０を移動体１２２から離間させておく。そして逆に図８ｂで示すように切り替えレバーで一方の超音波振動子１１４を矢印１３１方向に移動させてその振動片１２１を移動体１２２から離間させておき、他方の超音波振動子１１６を矢印１３２方向に切り替えてその振動片１３０を移動体１２２に接触させておいてその超音波振動子１１６を振動させることで移動体１２２を矢印１３４方向に移動させるようにしたものである。

【０００４】

【発明が解決しようとする課題】しかしながら、図７に示されている超音波駆動モータにおいては移動体を正逆方向に移動させることができない。また、図８に示されている超音波駆動モータにおいては移動体を正逆方向に移動させられるものの、切り替えレバーを切り替え動作させるのにアクチュエータが別途に必要となるうえそのレバーを高速に切り替えることも困難であるから切り替えレバーで切り替えるのは効率的にも好ましくない。さらに切り替えレバーとかアクチュエータなどが必要であるから全体の形状が複雑化してコスト的にも高くつくものとなるうえその薄型化とか小型化を容易には図れないという課題があった。

【０００５】

【課題を解決するための手段】本発明の超音波駆動モータにおいては、電気信号の印加により第１共振周波数で振動するものでかつこの振動による伸縮方向側端部に振動片を備えた第１超音波振動子と、電気信号の印加により前記第１共振周波数と異なる第２共振周波数で振動するものでかつ振動による伸縮方向側端部に振動片を備えた第２超音波振動子とを有し、前記両超音波振動子は互いに対して所定角度を有して配置されかつそれぞれの振動片が接続されていることを主たる特徴としたことによって、前記両超音波振動子に電気信号を印加してもそれぞれの共振周波数が異なるために前記両超音波振動子が

同時に共振振動しそれぞれの共振振動が合成されて移動体に接する振動片端部の振動軌跡が変化しないようなことがなく、したがって、切り替えレバーなしで移動体を電気信号の印加だけで正逆方向に切り替えて移動させられることになり、これにより上述の課題を解決できるようにしている。

【０００６】

【発明の実施の形態】以下、本発明の実施の形態に係る超音波駆動モータについて説明する。図１は本実施の形態の超音波駆動モータの斜視図であり、同図を参照して、本実施の形態の超音波駆動モータは、電気信号の印加により第１共振周波数ｆ１で振動する第１超音波振動子２と、前記第１共振周波数ｆ１とは異なる第２共振周波数ｆ２で振動する第２超音波振動子４とを備えている。各超音波振動子２，４それぞれは平面視長方形のものでその長手方向つまりそれの伸縮方向側端部中央部にその振動による伸縮方向に延びた振動片６，８を備えており、かつ互いに対して所定角度、本実施の形態では直角、を有して配置されている。そして互いの振動片６，８それぞれの先端部は互いに接合または一体などで接続されている。

【０００７】第１超音波振動子２は第１振動子部材１０とこれの両面の電極膜付きの第１、第２圧電部材１２，１４とからなり、また第２超音波振動子４は第２振動子部材１６とこれの両面の電極膜付きの第３、第４圧電部材１６，１８とからなっている。

【０００８】上記した構成の各超音波振動子２，４はそれぞれの長手方向中間でそれの短手方向に平行な線上の両側でそれぞれ平面視Ｔ型の第１～第４固定部材２２～２８それぞれで固定されている。各固定部材２２～２８は各超音波振動子２，４それぞれの振動子部材１０，１６と電気的機械的に接続されているとともに、それぞれ、適宜のモータ壁体に固定するためのビス挿通用の穴３０を有している。ここで、第２固定部材２４と第３固定部材２６はそれぞれ接続部材３２で一体に接続されている。そして、第１超音波振動子２の振動子部材１０両面の第１、第２圧電部材１２，１４と第２超音波振動子４の振動子部材１６両面の第３、第４圧電部材１８，２０それぞれの長手方向中央部における短手方向に平行な線上がその振動モードの節となっており、その長手方向と短手方向それぞれの中間の一点が通電点３４，３６とされている。ただし、第２圧電部材１４と第４圧電部材２０とについては図面にその通電点があらわれない。また前記接続部材３２の中央部にも通電点３８が構成されている。

【０００９】この超音波駆動モータの駆動回路４０は電気信号出力部４２～４６を有し、第１電気信号出力部４２は２本の通電線４８，５０それぞれを介して第１、第２圧電部材１２，１４それぞれの通電点に接続され、第２電気信号出力部４６は２本の通電線５２，５４それぞれを介して第３、第４圧電部材１８，２０それぞれの通電点に接続されている。また、電気信号出力部４４は通電線５６を介して接続部材３２の通電点３８に接続されている。

【００１０】ここで、各超音波振動子２，４それぞれの振動子部材１０，１６と固定部材２２～２８と、接続部材３２とは、それぞれ図２を参照するように、１枚の板状の導電性例えばステンレスのような金属体で作られた弾性部材５８でもって一体に構成されたものである。

【００１１】次に動作を説明すると、第１超音波振動子２が第１振動子部材１０と第１、第２圧電部材１２，１４それぞれの間に駆動回路４０の電気信号出力部４２，４４から各通電線４８，５０，５６を介して交流の電気信号が与えられかつこの交流電気信号の周波数が連続的に変化させられて第１共振周波数ｆ１になると第１、第２圧電部材１２，１４はそのインピーダンスが急激に低下するピークを呈し、これにより第１、第２圧電部材１２，１４それぞれに流れる電流が増大して第１超音波振動子２は共振状態となる。同様に、第２超音波振動子４が第２振動子部材１６と第３、第４圧電部材１８，２０それぞれの間に駆動回路４０の電気信号出力部４４，４６から各通電線５２～５６を介して交流の電気信号が与えられかつこの交流電気信号の周波数が連続的に変化させられて第２共振周波数ｆ２になると第３、第４圧電部材１８，２０のインピーダンスが急激に低下するピークを呈し、これにより第３、第４圧電部材１８，２０に流れる電流が増大して第２超音波振動子４は共振状態となる。

【００１２】そして、これら第１、第２超音波振動子２，４における各共振モードのうち、ある共振モードそれぞれにおいては第１超音波振動子２と第２超音波振動子４とはそれぞれの長手方向に伸縮するようにして振動する。この場合の振動の振幅は印加電圧の大きさに応じて変化するが、通常は各超音波振動子２，４それぞれの振動片６，８の互いの接続先端部が数μｍ程度の振幅で振動する。このとき第１超音波振動子２の長手方向に伸縮する共振モードの周波数ｆ１と第２超音波振動子４が長手方向に伸縮する共振モードの周波数ｆ２とは異なっているので、第１超音波振動子２が長手方向に伸縮するように振動しているときは第２超音波振動子４は振動しないし、その逆に第２超音波振動子４がそれの長手方向に伸縮するように振動しているときは第１超音波振動子２は振動しない。こうした第１超音波振動子２の振動片６の移動軌跡は図３ａ～ｃに、第２超音波振動子４の振動片８の移動軌跡は図４ａ～ｃにそれぞれ示されている。この移動軌跡は第１超音波振動子２については図３ａ→図３ｂ→図３ｃ→図３ｂ→図３ａと繰り返され、第２超音波振動子４については図４ａ→図４ｂ→図４ｃ→図４ｂ→図４ａと繰り返される。

【００１３】このようにして各超音波振動子２，４それ

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ぞれの振動片６，８の移動軌跡を変化させることで両振動片６，８の接合先端部に接触している移動体６０は図中の矢印ａ，ｂ方向に移動させられる。

【００１４】なお、各超音波振動子２，４それぞれの共振周波数ｆ１，ｆ２が同一であればそれぞれの振動片６，８の移動軌跡は図５ａ～ｃで示すようになり、移動体６０は移動しない。

【００１５】なお、上述の実施の形態においては、第１超音波振動子２の振動モードの節の位置つまりその長手方向中央部でその短手方向に平行な線上で第１超音波振動子２の第１振動子部材１０両側部をＴ型の第１、第２固定部材２２，２４で固定し、また、同様に、第２超音波振動子４の振動モードの節の位置つまりその長手方向中央部でその短手方向に平行な線上で第２超音波振動子４の両側部をＴ型の第３、第４固定部材２６，２８で固定しているので、本実施の形態の超音波駆動モータを各超音波振動子２，４それぞれに圧電部材を設けるとともに通電線で接続するだけの構成となるから超音波駆動モータとしては構成が簡単でその薄型化を図れる。

【００１６】なお、上述の実施の形態においては第１、第２超音波振動子２，４それぞれの形状を互いに異なったものとしてそれぞれの共振周波数ｆ１，ｆ２を異なったものにしてもよく、例えばそれぞれの長手方向つまり伸縮方向の長さを異なったものとすることによって、それぞれの共振周波数ｆ１，ｆ２を異なったものにしてもよい。

【００１７】なお、上述の実施の形態においては、第１、第２超音波振動子２，４それぞれの圧電部材の弾性定数を異なったものとしてそれぞれの共振周波数ｆ１，ｆ２を異なったものにしてもよい。

【００１８】上述の実施の形態においては、第１、第２超音波振動子２，４それぞれは第１～第４固定部材２２～２８でそれぞれの両側部を固定しているので、超音波駆動モータの剛性を上げられる結果、超音波駆動モータの推力の向上と異音の発生防止とが可能となるが、例えば図６で示すように前記各固定部材２２～２８のうち、第１、第４固定部材２２，２８を省略し、第２、第３固定部材２４，２６でもって第１、第２超音波振動子２，４それぞれの片側部で固定した場合では、超音波駆動モータの投影面積を小さくできるから全体のサイズを小型化にできる。

【００１９】

【発明の効果】以上のように本発明によれば次の効果を得られる。

【００２０】請求項１の発明によれば、電気信号の印加により第１共振周波数で振動するものでかつこの振動による伸縮方向側端部に振動片を備えた第１超音波振動子と、電気信号の印加により前記第１共振周波数と異なる第２共振周波数で振動するものでかつ振動による伸縮方向側端部に振動片を備えた第２超音波振動子とを有し、

6

前記両超音波振動子は互いに対して所定角度を有して配置されかつそれぞれの振動片が互いに接続されていることから、両超音波振動子に電気信号を印加してもそれぞれの共振周波数が異なるために前記両超音波振動子が同時に共振振動しそれぞれの共振振動が合成されて移動体に接する振動片端部の振動軌跡が変化しないようなことがなく、したがって、切り替えレバーなしで移動体を電気信号の印加だけで正逆方向に切り替えて移動させられることになるとともに、切り替えレバーが不要であるからそれのアクチュエータも不要となり正逆移動について動作上の効率化を図れるうえ、全体の形状が簡易となりコスト的にも安くできるものとなるとともにその薄型化とか小型化をも容易には図れる。

【００２１】請求項２の発明によれば、前記各超音波振動子それぞれが、振動子部材とこれの両面それぞれに設けられた圧電部材とで構成されかつ前記振動子部材の長手方向端部に前記振動片が設けられているから、全体の形状がより簡易となる。

【００２２】請求項３の発明によれば、導電性弾性部材でもって前記両超音波振動子それぞれの振動子部材と前記両超音波振動子それぞれを固定するための固定部材とが共通に形成され、かつその固定部材が前記両超音波振動子それぞれの伸縮方向振動モードの節に対応する位置に設けられていることから、超音波駆動モータとしての構成がより簡易かつ薄型化、小型化が可能となる。

【００２３】請求項４の発明によれば、両超音波振動子それぞれの長手方向の長さが異なることで前記共振周波数が互いに異なっていることから、共振周波数を異なるようにするのが全体構成の一層の薄型化が可能となる。

【００２４】請求項５の発明によれば、前記両超音波振動子それぞれの圧電部材は互いに弾性定数が異なっていることから、圧電部材の材料選定のみでよく、超音波振動子としての形状が共振周波数を変えることにより大きくならずに済み、これによ全体構成の一層の小型化が可能となる。

【００２５】請求項６の発明によれば、前記両超音波振動子それぞれに対する固定部材が伸縮方向の振動モードの節の両側位置に設けられていることから、超音波駆動モータの剛性があがり、超音波駆動モータの推力の向上と異音の発生を有効に防止できるものとなる。

【００２６】請求項７の発明によれば、前記両振動体それぞれに対する固定部材が伸縮方向振動モードの節の片側位置に設けられていることから、超音波駆動モータの投影面積が小さくなり、それだけ全体構成の一層の小型化を図れる。

【図面の簡単な説明】

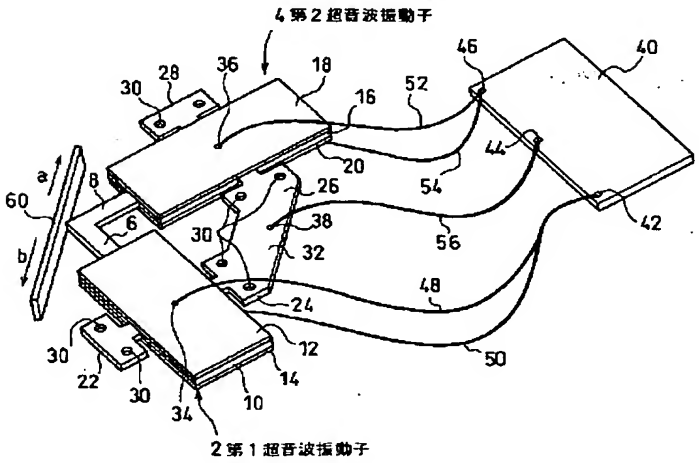
【図１】本発明の実施の形態に係る超音波駆動モータの斜視図

【図２】図１の振動子部材、固定部材などを構成する弾性部材の斜視図

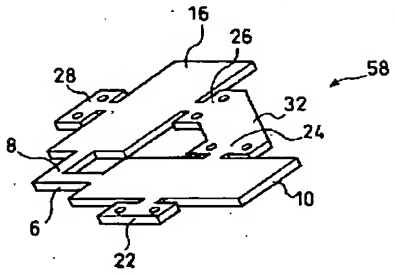
【図３】第１超音波振動子の振動片の移動軌跡を示す図
【図４】第２超音波振動子の振動片の移動軌跡を示す図
【図５】両超音波振動子の共振周波数が一致した場合の前記両振動片の移動軌跡を示す図
【図６】固定部材の他の変形例を示すための平面図
【図７】従来の超音波駆動モータの平面図
【図８】他の従来の超音波駆動モータの平面図
【符号の説明】
２　第１超音波振動子
４　第２超音波振動子

６，８　振動片
１０　第１振動子部材
１２，１４　圧電部材
１６　第２振動子部材
１８，２０　圧電部材
２２～２８　固定部材
３４，３６　振動モードの節
４０　駆動回路
４２～４６　電気信号出力部
４８～５６　通電線

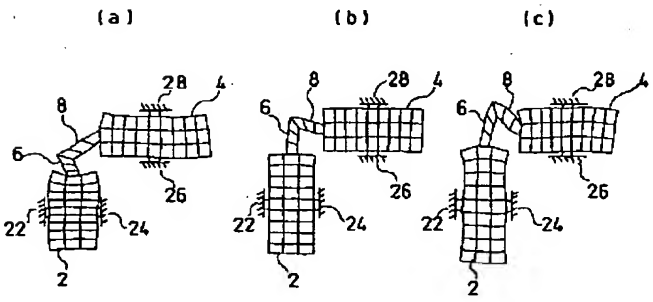
【図１】



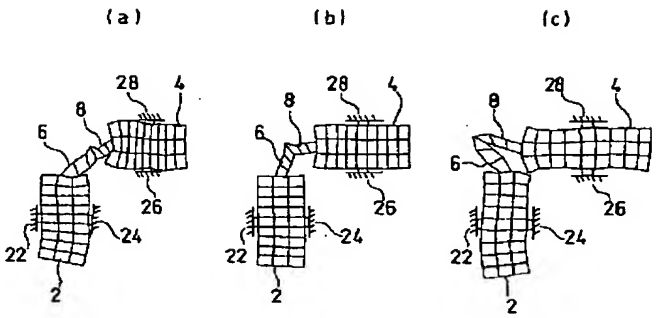
【図２】



【図３】



【図４】



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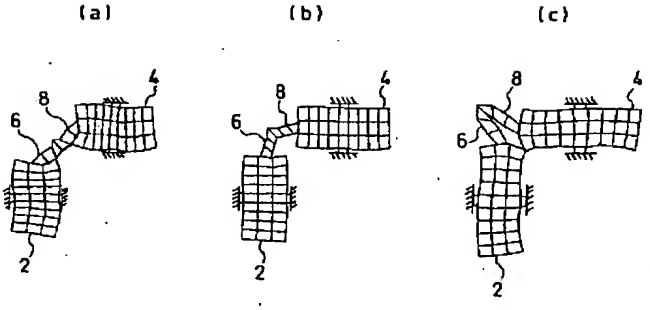

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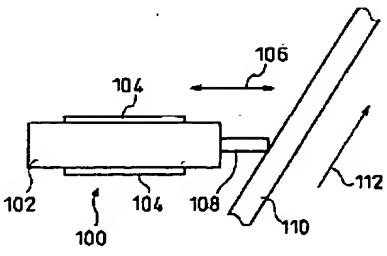
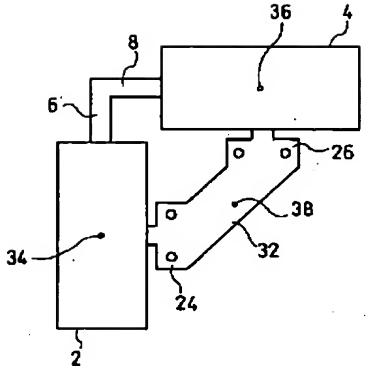
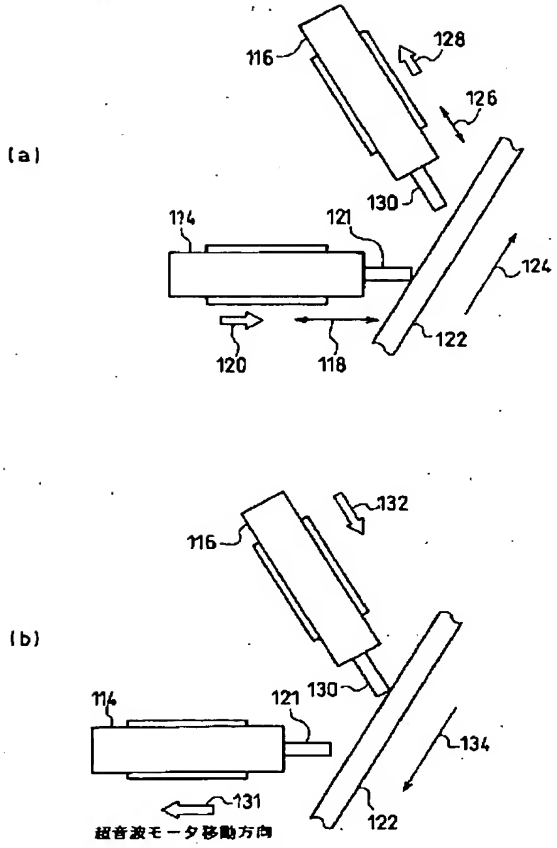


【図６】


36
4
8
6
26
38
34
32
24
2

【図８】


(a)
116
128
126
130
114
121
124
120
118
122
(b)
132
116
114
121
130
134
131
超音波モータ移動方向
122

PATENT ABSTRACTS OF JAPAN

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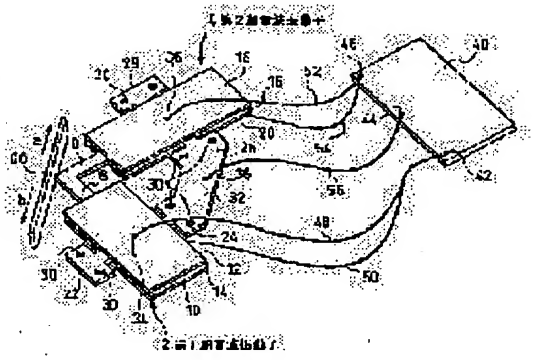
TANAKA TOSHIYUKI

(54) ULTRASONIC DRIVING MOTOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a motor which can drive a moving body in both forward and reverse directions without using a conventional forward/reverse switch lever, in other words, without using an actuator, and therefore enables an easy forward/reverse switch operation and obtains a high moving efficiency and which has a simple shape as a whole and thereby enables the reduction in cost, thickness and size.
SOLUTION: This motor has a first ultrasonic vibrator 2 which vibrates at a first resonance frequency f1 with application of an electric signal and has a vibrating piece at a side end in the expansion direction of the vibration and a second ultrasonic vibrator 4 which vibrates at a second resonance frequency f2, which is different from the first one, and has a vibrating piece at a side end in the expansion direction of the vibration. The ultrasonic vibrators 2, 4 are located at a specified angle and the vibrating pieces 6, 8 of the ultrasonic vibrators 2, 4 are connected.



LEGAL STATUS

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[Date of final disposal for application]	
[Patent number]	3265461
[Date of registration]	11.01.2002
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] It is the ultrasonic drive motor characterized by for both the aforementioned ultrasonic vibrators receiving mutually, and having a predetermined angle, and being arranged by having the 2nd ultrasonic vibrator characterized by providing the following, and connecting each oscillating piece mutually. The 1st ultrasonic vibrator which vibrates by the 1st resonance frequency by impression of an electrical signal, and equipped the flexible direction side edge section by vibration of a parenthesis with the oscillating piece. It is an oscillating piece to the flexible direction side edge section vibrate by the 2nd resonance frequency which differs from the 1st resonance frequency of the above by impression of an electrical signal, and according [and] to vibration.
[Claim 2] each of each aforementioned ultrasonic vibrator consists of a vibrator member and a piezo-electric member prepared in each of both sides of this -- having -- and the aforementioned vibrator -- the ultrasonic drive motor according to claim 1 characterized by preparing the aforementioned oscillating piece in the longitudinal direction edge of a member
[Claim 3] The ultrasonic drive motor according to claim 1 or 2 characterized by forming the holddown member for having by the conductive elastic member and fixing the vibrator member of each of both aforementioned ultrasonic vibrators, and each of both aforementioned ultrasonic vibrators in common, and preparing the holddown member in the position corresponding to the paragraph of the flexible direction oscillation mode of each of both aforementioned ultrasonic vibrators.
[Claim 4] There is no claim 1 characterized by the aforementioned resonance frequency differing mutually because the length of the longitudinal direction of each of both aforementioned ultrasonic vibrators differs, and it is the ultrasonic drive motor of a publication 3 either.
[Claim 5] There is no claim 1 characterized by elastic coefficients differing mutually, and the piezo-electric member of each aforementioned oscillating object of both is the ultrasonic drive motor of a publication 3 either.
[Claim 6] There is no claim 1 characterized by preparing the holddown member to each aforementioned oscillating object of both in the both-sides position of the paragraph of the oscillation mode of the flexible direction, and it is the ultrasonic drive motor of a publication 3 either.
[Claim 7] There is no claim 1 characterized by preparing the holddown member to each aforementioned oscillating object of both in the single-sided position of the paragraph of the flexible direction oscillation mode, and it is the ultrasonic drive motor of a publication 3 either.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to an ultrasonic drive motor.
[0002]
[Description of the Prior Art] Although an ultrasonic drive motor moves a mobile using flexible reciprocating movement of the ultrasonic vibrator with which it is equipped, there are some which use the stretching vibration in the longitudinal direction of a ultrasonic vibrator as the one method. Although such an ultrasonic drive motor is described by JP,59-37672,B A member 104 is prepared and constituted. for example, it explains with reference to drawing 7 -- as -- a ultrasonic vibrator 100 -- vibrator -- both sides of a member 102 -- piezo-electricity -- Make the oscillating piece 106 of the one side edge of the flexible direction shown by the arrow 106 of a ultrasonic vibrator 100 incline to a mobile 108, and it comes to attach. The vibrational motion by expansion and contraction of the direction of an arrow of a ultrasonic vibrator 100 can be changed now in the move direction shown by the arrow 112 of a mobile 110.
[0003] Moreover, the ultrasonic drive motor 1 or more sets could be made to carry out whose rectilinear motion to the right opposite direction of a mobile using the ultrasonic drive motor of such a method is also proposed by JP,59-194678,A etc. If this ultrasonic drive motor is explained with reference to drawing 8 , as drawing 8 a shows, it will have the ultrasonic vibrator 114,116 of the same composition as the above first. Have with the change lever which is not illustrated, while expands and contracts in the arrow 118 direction, and a ultrasonic vibrator 114 is changed in the arrow 120 direction. Make it vibrate, after contacting the oscillating piece 121 to a mobile 122, and a mobile 122 is moved in the right direction 124. Under the present circumstances, the ultrasonic vibrator 116 of another side which vibrates in the arrow 126 direction is moved in the arrow 128 direction, and the oscillating piece 130 is made to estrange from a mobile 122 in a change lever. And it is made to move a mobile 122 in the arrow 134 direction by moving one ultrasonic vibrator 114 in the arrow 131 direction with a change lever, making the oscillating piece 121 estrange from a mobile 122, as drawing 8 b shows conversely, changing the ultrasonic vibrator 116 of another side in the arrow 132 direction, contacting the oscillating piece 130 to a mobile 122, and vibrating the ultrasonic vibrator 116.
[0004]
[Problem(s) to be Solved by the Invention] However, in the ultrasonic drive motor shown in drawing 7 , a mobile cannot be moved to a right opposite direction. Moreover, since it is also difficult to change the lever at high speed in an actuator's being separately needed for carrying out change operation of the change lever, although a mobile is moved to a right opposite direction in the ultrasonic drive motor shown in drawing 8 , changing with a change lever is not efficiently desirable. The technical problem that the thin-shape-izing or miniaturization could not be easily attained in becoming what the whole configuration complicates and is attached in cost and highly, since the change lever, the actuator, etc. are still more nearly required occurred.
[0005]
[Means for Solving the Problem] The 1st ultrasonic vibrator which vibrates by the 1st resonance frequency by impression of an electrical signal, and equipped the flexible direction side edge section by vibration of a parenthesis with the oscillating piece in the ultrasonic drive motor of this invention, It has the 2nd ultrasonic vibrator which vibrates by the 2nd resonance frequency which differs from the 1st resonance frequency of the above by impression of an electrical signal, and equipped the flexible direction side edge section according [and] to vibration with the oscillating piece. By main having been characterized by receiving mutually, having a predetermined angle, and being arranged, and connecting each oscillating piece, both the aforementioned ultrasonic vibrators It follows so that oscillating tracing of the oscillating one end section which both the aforementioned ultrasonic vibrators carry out resonance vibration simultaneously, and each resonance vibration is compounded, and touches a mobile since each resonance frequency differs even if it impresses an electrical signal to both the aforementioned ultrasonic

vibrators may change. You change a mobile without a change lever to a right opposite direction only by impression of an electrical signal, and it is made to move, and enables it to solve an above-mentioned technical problem by this.

[0006]

[Embodiments of the Invention] Hereafter, the ultrasonic drive motor concerning the gestalt of operation of this invention is explained. Drawing 1 is the perspective diagram of the ultrasonic drive motor of the gestalt of this operation, and the ultrasonic drive motor of the gestalt of this operation is equipped with the 1st ultrasonic vibrator 2 which vibrates by the 1st resonance frequency f1 by impression of an electrical signal, and the 2nd ultrasonic vibrator 4 which vibrates by the 2nd different resonance frequency f2 from the 1st resonance frequency f1 of the above with reference to this drawing. each ultrasonic vibrators 2 and 4 -- each is the thing of a plane view rectangle, and equips the longitudinal direction, i.e., the flexible direction side edge section center section of that, with the oscillating pieces 6 and 8 prolonged in the flexible direction by the vibration, and receives mutually, with the gestalt of a predetermined angle and this operation, has a right angle and is arranged and the mutual oscillating pieces 6 and 8 -- each point of each other is connected by junction or one

[0007] the 1st ultrasonic vibrator 2 -- the 1st vibrator -- the 1st with the electrode layer of a member 10 and both sides of this, and the 2nd piezo-electricity -- from members 12 and 14 -- becoming -- moreover, the 2nd ultrasonic vibrator 4 -- the 2nd vibrator -- the 3rd with the electrode layer of a member 16 and both sides of this -- it consists of members 16 and 18 the 4th piezo-electricity

[0008] the both sides on a line with each ultrasonic vibrators 2 and 4 of composition of having described above parallel to the direction of a short hand of that in each longitudinal direction middle -- respectively -- the plane view T type 1st - the 4th holddown member 22-28 -- it comes out, respectively and is fixed each holddown members 22-28 -- each ultrasonic vibrators 2 and 4 -- each vibrator -- while connecting with members 10 and 16 electrically mechanically, it has the hole 30 for the screw insertion for fixing to a proper motor wall, respectively Here, the 2nd holddown member 24 and the 3rd holddown member 26 are connected to one by the connection material 32, respectively. and the vibrator of the 1st ultrasonic vibrator 2 -- a member -- the 1st of ten both sides, and the 2nd piezo-electricity -- the vibrator of members 12 and 14 and the 2nd ultrasonic vibrator 4 -- a member -- the 3rd of 16 both sides, and the 4th piezo-electricity -- members 18 and 20 -- the line top parallel to the direction of a short hand in each longitudinal direction center section serves as a paragraph of the oscillation mode, and one middle point of the longitudinal direction and each direction of a short hand is made into the energizing points 34 and 36 However, about a member 20, the energizing point does not appear in a drawing the 4th piezo-electricity with a member 14 the 2nd piezo-electricity. Moreover, the energizing point 38 is constituted by the center section of the aforementioned connection material 32.

[0009] the drive circuit 40 of this ultrasonic drive motor -- the electrical signal output sections 42-46 -- having -- the 1st electrical signal output section 42 -- two energization lines 48 and 50 -- each -- minding -- the 1st and the 2nd piezo-electricity -- members 12 and 14 -- it connects with each energizing point -- having -- the 2nd electrical signal output section 46 -- two energization lines 52 and 54 -- each -- minding -- the 3rd and the 4th piezo-electricity -- members 18 and 20 -- it connects with each energizing point Moreover, the electrical signal output section 44 is connected to the energizing point 38 of the connection material 32 through the energization line 56.

[0010] here -- each ultrasonic vibrators 2 and 4 -- each vibrator -- it has members 10 and 16, holddown members 22-28, and the connection material 32 by the elastic member 58 made from the conductivity of the tabular of one sheet, for example, a metal body like stainless steel, and they are constituted by one so that drawing 2 may be referred to, respectively

[0011] Next, if operation is explained the 1st ultrasonic vibrator 2 -- the 1st vibrator -- a member 10, and the 1st and the 2nd piezo-electricity -- members 12 and 14 -- between each Each energization lines 48, 50, and 56 are minded from the electrical signal output sections 42 and 44 of the drive circuit 40. The electrical signal of an alternating current is given, and if the frequency of the alternating current electrical signal of a parenthesis is changed continuously and turns into the 1st resonance frequency f1, members 12 and 14 will present the 1st and the peak to which the impedance falls rapidly the 2nd piezo-electricity. thereby -- the 1st and the 2nd piezo-electricity -- members 12 and 14 -- it will be alike, respectively, the flowing current will increase, and the 1st ultrasonic vibrator 2 will be in the resonance state Similarly the 2nd ultrasonic vibrator 4 -- the 2nd vibrator -- a member 16, and the 3rd and the 4th piezo-electricity -- members 18 and 20 -- between each Each energization lines 52-56 are minded from the electrical signal output sections 44 and 46 of the drive circuit 40. The electrical signal of an alternating current is given, and if the frequency of the alternating current electrical signal of a parenthesis is changed continuously and turns into the 2nd resonance frequency f2, the impedance of members 18 and 20 will present the 3rd and the peak which falls rapidly the 4th piezo-electricity. The 3rd and the current

which flows to members 18 and 20 the 4th piezo-electricity will increase by this, and the 2nd ultrasonic vibrator 4 will be in the resonance state.

[0012] And among each resonance mode in these [1st] and the 2nd ultrasonic vibrator 2 and 4, in each of a certain resonance mode, the 1st ultrasonic vibrator 2 and the 2nd ultrasonic vibrator 4 vibrate to it, as it expands and contracts in each longitudinal direction. although the amplitude of vibration in this case changes according to the size of applied voltage -- usually -- each ultrasonic vibrators 2 and 4 -- the mutual connection point of each oscillating piece 6 and 8 vibrates with the amplitude which is about several micrometers While vibrating so that the 1st ultrasonic vibrator 2 may expand and contract in a longitudinal direction, since it differs from the frequency f2 of the resonance mode which the frequency f1 of the resonance mode expanded and contracted in the longitudinal direction of the 1st ultrasonic vibrator 2 at this time and the 2nd ultrasonic vibrator 4 expand and contract in a longitudinal direction, the 2nd ultrasonic vibrator 4 does not vibrate, and while [that] vibrating so that the 2nd ultrasonic vibrator 4 may expand and contract in the longitudinal direction of that conversely, the 1st ultrasonic vibrator 2 does not vibrate. Move tracing of the oscillating piece 6 of such 1st ultrasonic vibrator 2 is shown in drawing 3 a-c, and move tracing of the oscillating piece 8 of the 2nd ultrasonic vibrator 4 is shown in drawing 4 a-c, respectively. This move tracing is repeated about the 1st ultrasonic vibrator 2 with drawing 3 a-> drawing 3 b-> drawing 3 c-> drawing 3 b-> drawing 3 a, and is repeated about the 2nd ultrasonic vibrator 4 with drawing 4 a-> drawing 4 b-> drawing 4 c-> drawing 4 b-> drawing 4 a.

[0013] thus, each ultrasonic vibrators 2 and 4 -- the mobile 60 which touches the junction point of both the oscillating pieces 6 and 8 by changing move tracing of each oscillating piece 6 and 8 is moved in Arrow a and the direction of b of [in drawing]

[0014] in addition, each ultrasonic vibrators 2 and 4 -- if each resonance frequency f1 and f2 is the same, drawing 5 a-c will come to show move tracing of each oscillating piece 6 and 8, and a mobile 60 will not move

[0015] A ten member flank is fixed by the T type 1st and the 2nd holddown member 22 and 24 the 1st vibrator. in addition, the gestalt of above-mentioned operation -- setting -- a line top parallel, the position, i.e., the longitudinal direction center section, of a paragraph of the 1st ultrasonic vibrator 2, to the direction of a short hand -- the 1st ultrasonic vibrator 2 -- similarly [of the oscillation mode] Since the both-sides section of the 2nd ultrasonic vibrator 4 is fixed by the T type 3rd and the 4th holddown member 26 and 28 on a line parallel, the position, i.e., the longitudinal direction center section, of a paragraph of the 2nd ultrasonic vibrator 4, to the direction of a short hand, [of the oscillation mode] the ultrasonic drive motor of the gestalt of this operation -- each ultrasonic vibrators 2 and 4 -- since it becomes the composition connected by the energization line while it is alike, respectively and preparing a piezo-electric member, as an ultrasonic drive motor, composition is easy, and the thin shape-ization can be attained

[0016] in addition, the gestalt of above-mentioned operation -- setting -- the 1st and the 2nd ultrasonic vibrator 2 and 4 -- it is good as for what is different in each resonance frequency f1 and f2 as what is mutually different in each configuration, for example, is good by having differed the length of each longitudinal direction, i.e., the flexible direction, as for what is different in each resonance frequency f1 and f2

[0017] in addition, the gestalt of above-mentioned operation -- setting -- the 1st and the 2nd ultrasonic vibrator 2 and 4 -- each piezo-electricity -- it is good as for what is different in each resonance frequency f1 and f2 as what is different in the elastic coefficient of a member

[0018] the gestalt of above-mentioned operation -- setting -- the 1st and the 2nd ultrasonic vibrator 2 and 4, although improvement in the thrust of an ultrasonic drive motor and generating prevention of an allophone are attained as a result of being able to raise the rigidity of an ultrasonic drive motor since each is fixing each both-sides section by the 1st - the 4th holddown member 22-28 For example, as drawing 6 shows, the 1st and the 4th holddown member 22 and 28 are omitted among each aforementioned holddown members 22-28. the 2nd and the 3rd holddown member 24 and 26 -- having -- the 1st and the 2nd ultrasonic vibrator 2 and 4 -- in the case where it fixes in each single-sided section, since projected area of an ultrasonic drive motor can be made small, the whole size is made to a miniaturization

[0019]

[Effect of the Invention] According to this invention, the following effect can be acquired as mentioned above.

[0020] The 1st ultrasonic vibrator which according to invention of a claim 1 vibrates by the 1st resonance frequency by impression of an electrical signal, and equipped the flexible direction side edge section by vibration of a parenthesis with the oscillating piece, It has the 2nd ultrasonic vibrator which vibrates by the 2nd resonance frequency which differs from the 1st resonance frequency of the above by impression of an electrical signal, and equipped the flexible direction side edge section according [and] to vibration

with the oscillating piece. From receiving mutually, and having a predetermined angle, and it being arranged, and each oscillating piece being connected mutually, both the aforementioned ultrasonic vibrators As [change / oscillating tracing of the oscillating one end section which both the aforementioned ultrasonic vibrators carry out resonance vibration simultaneously, and each resonance vibration is compounded, and touches a mobile since each resonance frequency differs even if it impresses an electrical signal to both ultrasonic vibrators] Therefore, while changing a mobile without a change lever to a right opposite direction only by impression of an electrical signal and being made to move Since the change lever is unnecessary, in the actuator of that also becoming unnecessary and being able to attain the increase in efficiency on operation about right back-migration, while becoming what the whole configuration becomes simple and is made in cost and at a low price, the thin-shape-izing and miniaturization can also be attained easily.

[0021] according to invention of a claim 2, each of each aforementioned ultrasonic vibrator consists of a vibrator member and a piezo-electric member prepared in each of both sides of this -- having -- and the aforementioned vibrator -- since the aforementioned oscillating piece is prepared in the longitudinal direction edge of a member, the whole configuration becomes simpler

[0022] According to invention of a claim 3, since the holddown member for having by the conductive elastic member and fixing the vibrator member of each of both aforementioned ultrasonic vibrators and each of both aforementioned ultrasonic vibrators is formed in common and the holddown member is prepared in the position corresponding to the paragraph of the flexible direction oscillation mode of each of both aforementioned ultrasonic vibrators, thin-shape-izing and the miniaturization of the composition as an ultrasonic drive motor are attained more simply.

[0023] According to invention of a claim 4, since the aforementioned resonance frequency differs mutually because the length of the longitudinal direction of each of both ultrasonic vibrators differs, much more thin shape-ization of whole composition of making resonance frequency differ is attained.

[0024] piezo-electricity since the piezo-electric members of each of both aforementioned ultrasonic vibrators differ in the elastic coefficient mutually according to invention of a claim 5 -- when the configuration as a ultrasonic vibrator changes resonance frequency only for the material selection of a member, don't become large and be fastidious -- be alike -- much more miniaturization of whole composition is attained

[0025] According to invention of a claim 6, since the holddown member to each of both aforementioned ultrasonic vibrators is prepared in the both-sides position of the paragraph of the oscillation mode of the flexible direction, the rigidity of an ultrasonic drive motor goes up and improvement in the thrust of an ultrasonic drive motor and generating of an allophone can be prevented effectively.

[0026] According to invention of a claim 7, since the holddown member to each aforementioned oscillating object of both is prepared in the single-sided position of the paragraph of the flexible direction oscillation mode, the projected area of an ultrasonic drive motor becomes small, and much more miniaturization of whole composition can be attained so much.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective diagram of the ultrasonic drive motor concerning the gestalt of operation of this invention
[Drawing 2] The perspective diagram of the elastic member which constitutes the vibrator member of drawing 1 , a holddown member, etc.
[Drawing 3] Drawing showing move tracing of the oscillating piece of the 1st ultrasonic vibrator
[Drawing 4] Drawing showing move tracing of the oscillating piece of the 2nd ultrasonic vibrator
[Drawing 5] Drawing showing move tracing of both the aforementioned oscillating piece when the resonance frequency of both ultrasonic vibrators is in agreement
[Drawing 6] The plan for other modifications of a holddown member being shown
[Drawing 7] The plan of the conventional ultrasonic drive motor
[Drawing 8] The plan of other conventional ultrasonic drive motors
[Description of Notations]
2 1st Ultrasonic Vibrator
4 2nd Ultrasonic Vibrator
6 Eight Oscillating piece
10 It is Member 1st Vibrator.
12 and 14 piezo-electricity -- member
16 It is Member 2nd Vibrator.
18 and 20 piezo-electricity -- member
22-28 Holddown member
34 36 Paragraph of the oscillation mode
40 Drive Circuit
42-46 Electrical signal output section
48-56 Energization line

[Translation done.]